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Van Tran and IEPA file additional documents

In the lawsuit filed against Van Tran Electric by the Illinois Environmental Protection Agency, both parties have filed documents pertaining to Van Tran's motion to dismiss the complaint. Last Thursday, Van Tran filed a brief in support of its motion to dismiss. On Monday, IEPA filed a response in opposition to the motion to dismiss.

Listed below are the arguments Van Tran included in its brief in support of its motion to dismiss:

- IEPA cannot bring its "enforcement action" in this Court, and the Court is powerless to entertain it, or any injunction request under Section 42 of the Act;

- While evidence of 10-year-old events could be relevant in an enforcement hearing before the Board of Pollution Control, it is not relevant to a claim for immediate injunction under Section 43 of the Act;

- Evidence of past discharges are immaterial to a claim for an immediate injunction;

- IEPA is not inhibited by Van Tran's request for injunction in the companion case from taking remedial measures off of Van Tran's property, if it believes that evidence off-site contamination, regardless of source, creates a substantial danger to public health or welfare;

- The Complaint and the evidence show that IEPA is not seeking access to Van Tran's property to determine if there is a substantial present danger of a discharge from the site, but rather to

perform a "study" preparatory to taking action with respect to material on the site;

- IEPA is attempting to use this forum to establish a right to enter private property when it determines there has been a "release" wholly on such private property;

- IEPA's proposition is, under applicable statutes and regulations, questionable at best, but in any event the important issues of statutory and constitutional law raised by IEPA's interpretation of its regulations should be addressed only after a full opportunity for discovery and for development of the facts at a plenary trial;

- The "solvent pit", which Van Tran is attempting to remove, is being held hostage by IEPA to further an underlying objective, which is to force Van Tran to "voluntarily" perform the "RIFS" which IEPA has issued on its own;

- IEPA has not evaluated Van Tran's proposal for immediate removal of "solvent pit" materials as required;

- If Van Tran agrees to perform the "RIFS" it will have no opportunity to question nor litigate the scope and expense of same as it would if IEPA performs it;

- The profits and revenues from Van Tran's Vandalia operations will not permit it to "voluntarily" agree to perform the RIFS;

- IEPA is attempting not to preserve the status quo, but to change it irreparably.

In its response to the motion to dismiss, IEPA states that a hearing was held on Jan. 30 and 31 on this complaint and the one filed against the IEPA by Van Tran.

At the close of the evidence and after closing arguments, but prior to the court's ruling, Van Tran filed a motion to dismiss the IEPA complaint.

IEPA states that Van Tran is arguing that it was not afforded a hearing before the state Pollution Control Board and that IEPA "has failed to exhaust administrative remedies which are a precondition to this court's jurisdiction."

IEPA claims that the court and pollution board have "concurrent jurisdiction to address violation of the Environmental Protection Act."

It also claims that the court has the jurisdiction to "hear injunctive actions brought by the Illinois Attorney General's office pursuant to the act, and such is the case even where administrative proceedings are in progress."

"There is no policy of this state that requires trial courts to defer administrative proceedings in cases involving environmental matters," IEPA claims.

In addition, it claims, Van Tran has "waived its right to contest the jurisdiction of this court to hear IEPA request for preliminary injunction, since Van Tran participated in the two-day hearing without objection."

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BELLEVILLE
News Democrat
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Disposal company appeals to state

By JUNE LEONARD
News-Democrat

BELLEVILLE — Attorneys for a waste disposal company made their pitch to a state Pollution Control Board Thursday, hoping the board will reverse a St. Clair County Board decision denying them a permit to operate a landfill near Columbia.

Opponents maintain that the proposed landfill would harm groundwater, tie up traffic and reduce property values in the area.

The state Board must decide by April 1 whether to refer the county board's Nov. 25 decision to deny a landfill permit to Browning-Ferris Industries of Illinois.

Browning-Ferris had wanted to develop a 77-acre landfill on Columbia

Quarry Road near Illinois 158. Company's officials said they planned to spend \$5 million to make the landfill safe.

They also said the landfill would not significantly affect traffic patterns in the area, and that it would not reduce property values.

Hearing officer Allen Shoenberger, who conducted Thursday's hearing at the St. Clair County Courthouse, said he expected the state board would decide the case at a March 27 meeting.

The hearing lasted six hours. About 50 people attended.

Attorneys for Browning-Ferris and attorneys representing both People Against the Landfill and the city of Columbia all claimed that St. Clair County had been "fundamentally un-

fair" in its handling of the issue.

"After they closed the record on this case, members of the environmental committee considered and were persuaded by an article that appeared on the front page of the Belleville News-Democrat on Oct. 27 which consisted of an interview with an Illinois EPA representative who did not testify in this case," said Fred Prillaman, representing Browning-Ferris.

He also argued the state should reverse the County Board's decision because of insufficient evidence that the landfill was unnecessary and would cause traffic problems.

James Yoho, attorney for People Against the Landfill, said some residents of the area surrounding the

landfill had not been informed of one of the county public hearings at the required time.

Yoho argued the County Board had been "fundamentally unfair" because the Sept. 24 hearing was so crowded that not everyone could be seated or even fit in the room.

"You can't run a meeting past a polite hour and expect people to participate and be able to get up the next day and go to work," he said.

Yoho and others complained the Sept. 24 hearing had lasted from 7:30 p.m. until about 2 a.m. the next day.

Nearly a dozen residents stayed at Thursday's hearing long enough to take part in public comment after the attorneys had presented their cases.

Walter Byerley Sr., who owns a

home a mile from the proposed landfill site said he felt "second class" when representatives of Browning-Ferris were given seats at the crowded Sept. 24 hearing while many residents had to stand in the hallway.

"The room was extremely crowded. It was hot," he said. "I don't blame the county, but it was inadequate."

Al Peters, a spokesman for People Against Landfill who lives a mile from the proposed site, said the only reason he has water in his well is because of a crack 5 feet above the shaft in the limestone near his house.

"Browning-Ferris made a contention... that they had blasted down enough that anything below was solid," he said. But Peters said the well had only drilled 60 feet.

Order forbidding any landfill work issued by judge

By MARTHA SULLIVAN
Pentagraph staff

EUREKA — Exactly one month after Richard McCormick agreed to cease operations at his landfill near Minonk a Woodford County judge yesterday issued a temporary restraining order banning Mr. McCormick from operations at the landfill.

At an Illinois Pollution Control Board hearing Feb. 4, McCormick admitted to 13 allegations of improper operations at the 17-acre site and agreed to pay a \$16,000 fine and forever refrain from manufacturing activities there.

But reports of open burning and dumping of refuse after Feb. 4 prompted the state Environmental Protection Agency to conduct an investigation last week.

John Trippes of the EPA office in Peoria said yesterday he documented open burning at the landfill during a three-day investigation, but no trucks were seen dumping.

However, he added, the amount of refuse at the site increased over the three days.

The restraining order issued yesterday, which is effective immediately, differs from the Pollution Control Board order only in that the EPA may now post signs saying the landfill is closed, Trippes said.

Because the EPA has no punitive powers the environmental controls division of the state Attorney General's office sought the injunction.

"This was the result of a turnover of jurisdiction," said Trippes.

Huntley landfill decision due by state in 2 weeks

By Paul Harth

WOODSTOCK — The Illinois Pollution Control Board will decide within the next two weeks whether to uphold McHenry County's rejection of an application for a landfill near Huntley.

A PCB hearing officer Friday collected briefs and listened to arguments from nearly a dozen lawyers involved in the case, including those representing the petitioner, McHenry County Landfill Inc.

The company wants to build a 113-acre, non-hazardous sanitary landfill and recycling center on farmland off Illinois 6 two miles north of Huntley.

The application initially was turned down by the county board in March 1985 after local officials decided the company had failed to meet three of six criteria necessary under state law for approval.

The company appealed to the PCB, which sent the case back before the county for a new vote using a less strict standard of proof. The application again was

rejected by the county in October.

McHenry County Landfill pursued its appeal before the PCB and also went into the circuit court seeking an order allowing it to go directly to the Illinois Environmental Protection Agency for a permit.

THAT MOTION was based on the company's contention that the county and the PCB had failed to act on the application and appeal within the time prescribed by state law. Company lawyers say the statute considers the petition approved if those deadlines are not met.

Attorneys for the county and landfill objectors, who include several local governmental units, citizen and environmental groups and nearby property owners, dispute that contention.

A circuit court judge earlier this week refused to grant the order, saying he lacked jurisdiction, and told the company to pursue its arguments before the PCB.

County Landfill attorneys did that through briefs filed Friday.

along with ones covering the county board's decision to turn down the application.

Briefs also were filed by several of the other lawyers addressing the company's arguments.

A motion by David Ackemann, a special assistant state's attorney, to dismiss County Landfill's petition was denied. Ackemann served as a hearing officer during the public hearing on the application.

PCB hearing officer Todd Parkhurst, who also Friday denied several other motions by lawyers for both sides, said it would be up to the state board to decide their merits when it meets to discuss the appeal.

ALTHOUGH County Landfill attorneys still contend that the application should be deemed approved, lawyers Friday generally agreed that the PCB must make its decision on the appeal by March 14 to meet the deadlines imposed by state law.

Either side can then take the case before the 2nd District Appellate Court in Elgin.

Monsanto Is Praised For Handling Of Leak

By H.J. Jackson
Of the Post-Dispatch Staff

Neighbors of Monsanto's W.G. Kreschmer Plant in Sauget said they were pleased with the company's response to an accidental chemical leak Monday night that sent 17 people to Metro East hospitals. Only one of the 17 was kept overnight.

One critical note was sounded by an Illinois Environmental Protection Agency official. He questioned why Monsanto safety officials had waited 50 minutes to notify the state Emergency Services Disaster Agency in Springfield, Ill.

"We don't question that they had other concerns," said Will Flowers, a spokesman for the agency in Springfield. "We do question the call coming 51 minutes after the release."

Donna Vandiver, a spokeswoman

for Monsanto, said that plant officials had called officials in East St. Louis, Sauget and Cahokia as well as neighboring manufacturers.

"There's a continuous roster of numbers that we call," Vandiver said. "We call the nearby communities first. Our first concern is the safety of the people."

Manufacturers in Illinois are required to call the state emergency agency when a chemical leak occurs. That agency then notifies other state agencies.

The alarms sounded at 8:01 p.m.; the all-clear signal sounded at 8:40 p.m. Officials at the emergency service agency were notified at 8:51 p.m., Flowers said.

The leak occurred in the plant's acid division. A weld failed on a pipe, leading to the leak of about 100

pounds of chlorosulfonic acid. The acid is a chemical that is used in several compounds, from paints to pharmaceuticals. The acid vaporizes when it comes in contact with moisture.

Wilma Company, 41, a Monsanto employee, was the only person hospitalized overnight. She had complained of respiratory ailments. She was released Tuesday from St. Mary's Hospital in East St. Louis.

Sixteen other people had complained of similar symptoms and were treated at various hospitals and were then released. Most victims worked in a railroad yard east of the plant.

Monsanto and other chemical manufacturers in Sauget have been criticized in the past for their handling of accidental chemical emissions.

But in this instance, Metro East neighbors of Monsanto praised the way Monsanto handled the leak.

George Foster, head of disaster services for East St. Louis, said the sirens had worked properly for both the alert and the "all-clear." The sirens were installed a year ago by the chemical companies to alert area residents of chemical spills and gas emissions.

East St. Louis Fire Chief Bruce Hill said that the people at Monsanto "were very cooperative. We got prompt information about what went on."

Sauget Fire Chief Marvin Ogden said the incident had happened quickly and never had threatened his village.

Wind blew the chemical vapors to the east, so Cahokia was unaffected.

C-49

U.S. dairy industry stunned by pesticide-tainted herds

LITTLE ROCK, Ark. (AP) — Pesticide contamination of dairy herds in Arkansas and surrounding states has spawned one of the most serious financial problems the nation's dairy industry has faced in years, a federal official said Sunday.

Michael Masterson, a special assistant to Agriculture Secretary Richard Lyng, will head a task force scheduled to visit Arkansas, Oklahoma and Missouri on Tuesday to assess economic damages facing farmers.

Nearly 100 dairy farms in Arkansas and Missouri are under quarantine and cannot sell milk because cattle were found to have

eaten feed contaminated with the pesticide heptachlor.

Herds in Oklahoma are being tested for heptachlor, which was banned in 1983 after it was linked to cancer in tests on rats. The order banning it, however, permitted users to continue operations with the products until they exhausted supplies on hand.

The latest recalls came Sunday after state Health Department officials announced more milk and milk products that exceeded federally allowed levels of heptachlor contamination.

The recalls included: 38,000 16-ounce and

24-ounce cartons of Coleman Dairy cottage cheese; more than 2,000 half-gallon containers of IGA and Borden whole milk; 5,200 gallon containers of Blossom Time milk packed for Safeway; and about 200 half-gallon containers of milk delivered to homes and restaurants by Humphries Dairy of Hot Springs. All the products were distributed only in Arkansas.

Officials have said that Valley Feeds of Van Buren sold the contaminated feed.

Masterson said in a telephone interview from Washington that officials want to determine if the federal Food and Drug Adminis-

tration and state officials "have actually contained the problem as far as the contaminated milk going to the consumer. Our one goal is to ensure that the public health and safety is being protected."

"At the same time, this involves a significant economic loss for the dairy farmers," he said. "We want to talk to them and get the particulars of how long they feel the cows were on the feed and other facts and data."

The state Health Department has recommended that pregnant and nursing women and children under the age of 1 drink powdered milk rather than fresh because babies

are particularly susceptible to toxins. Others can continue to drink store-bought milk, officials say.

Dr. Stuart Fitzhugh, a state Health Department deputy director, said Friday that the level of heptachlor found in the breast milk was not high enough to warrant mothers switching to formulas if they have stopped drinking contaminated milk.

However, Dr. Greg Kresse of Eureka Springs said that he ordered all his patients to stop nursing. He said heptachlor is stored in body fat so breast milk is not necessarily safe if mothers stop consuming dairy products.

New herbicides ferocious

By Norm Heikens
Of The Southern Illinoisian

To the delight of farmers and gardeners, some weeds may commit suicide if ferocious, newly developed herbicides reach the market.

Thirteen new substances that are expected to supplement the original "Laser" herbicide, called by some experts the greatest agronomic development of the decade, have been discovered by a University of Illinois researcher.

The original Laser herbicide, discovered two years ago, causes plants to literally commit suicide, according to agronomist Constantin Rebeitz.

"Nothing can resist it," Rebeitz said. "You can kill anything with it with the right combination." Discovery of laser herbicides was a spinoff of research conducted at the U of I in 1964 but wasn't developed until 1984, he said.

Upon news of the finding, many in the industry began hoping for a safe, effective and economical weedkiller.

Introduction of the chemicals may not reach the market for several years, but "we're talking very, very seriously with quite a few manufacturers," Rebeitz said.

The herbicide, made from amino acids found in plant and animal cells, works quickly. Amino acids

"You can kill anything with it with the right combination."

Southern Illinoisian, Saturday, March 8, 1986

are basic cell building blocks. The acids convert rapidly into more immediate cell building blocks of chlorophyll. When combined with sunlight, the acids become excited and pass the excitement on to oxygen in the cell.

The cell then dies.

New substance combinations will work much like alphabet letters combined to form words, Rebeitz said. Weed-fighting programs can be tailored for a specific field, similar to herbicides in use today.

Rebeitz said that isn't the herbicide's only advantage.

It's likely that the new herbicides will be cheaper than weed killers sold today at prices ranging from \$5 to \$70 per gallon, he said.

Low production costs will be the reason, he explained. "They (herbicide users) are going to have a very nice system of herbicides," Rebeitz said. "It's a tremendous flexibility."

"This will eat up a very big share of the market until they come up with a chemical as safe as this one — if they can," he said.

Laser herbicides are as environmentally safe as well, he said. Because the active ingredients are organic, the herbicide will decompose with the dead plant.

The time it takes for a plant to die is short — as quickly as 15 minutes in laboratory conditions and within a day in the field, he said.

Some herbicides currently in use need nearly two weeks, he said.

Reitz's discovery was called one of the top 100 scientific innovations of 1984 and the decade's "most dramatic agricultural development" by Science Digest magazine.

In the future, the principle may be applied to pesticides, he said.

During the research, Rebeitz discovered a new plant classification system based on the manner that various plants form chlorophyll, the pigment that gives plants their green color.

Chlorophyll triggers photosynthesis, which converts sunlight into plant food. Several forms of chlorophyll chemical species exist.

Southern Illinoisian Dairy quarantine list rises to 64

LITTLE ROCK, Ark. (AP) — The state placed 31 more dairies on a quarantine list, bringing to 64 the number found to have milk contaminated with a pesticide that has led to recalls in six states, a health official said Tuesday.

The states involved in the recall are Arkansas, Oklahoma, Missouri, Mississippi, Kansas and Tennessee.

Tom Butler, deputy director for administration for the state Health Department, said a few dairy farms had been released from the quarantine list and 31 had been added to it for a total of 64 quarantined farms. He said tests had cleared 81 farms in Arkansas.

State veterinarian Taylor Woods said he expected the number of dairy herds quarantined because of contamination by heptachlor to grow.

The U.S. attorney's office at Fort Smith, meanwhile, on Tuesday requested a federal court order to bar the sale of contaminated cattle feed by a Van Buren feed mill and gasohol operation blamed as the source of the contamination.

County may block bacteria test

From Chicago Tribune wire

ST. CHARLES, Mo. — Monsanto Co.'s planned test of genetically engineered bacteria at an experimental farm may be delayed or halted by St. Charles County officials who are seeking legal advice about the matter. County counselor W. Randolph Weber will be asked by the county's planning department whether Monsanto must obtain a zoning change for the site before conducting the test, the department said. Monsanto has asked the U.S. Environmental Protection Agency for permission to test the bacteria at its farm west of St. Charles. Monsanto wants to plant corn seeds coated with a bacteria that is able to produce a pesticide in order to kill insects that prey on corn roots.

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The president also "shared the secret" with the prime minister of Malaysia over a White House lunch, the magazine said. Reagan is scheduled to announce his decision next Sunday.

The Newsweek poll showed Reagan's approval rating has climbed to 56 percent, its highest level in 2½ years and the best for a candidate in the fourth year of his presidency since Eisenhower.

The poll showed the percentage of voters strongly disapproving of Reagan's performance has dropped from 35 percent in September 1982 to 20 percent this month, with Democrats in the strongly negative category dropping from 58 percent to 30 percent.

The magazine said Reagan worked on his re-election announcement with a speechwriter during his Christmas trip to California. The five-minute speech is described by a Reagan adviser as "a humble appeal for support" which acknowledges that the nation still faces serious problems.

The poll, conducted by the Gallup Organization, was based on telephone interviews with 1,015 adults between Jan. 9-15. The margin of error is plus or minus 4 percentage points.

Chemical tank leak Sauget injures 70

SAUGET (AP) — An ice chunk may have fallen on the nozzle of a corrosive chemical storage tank Sunday, releasing a toxic liquid whose fumes injured more than 70 people, authorities said.

Sarah Gaines Collins, a spokesman for Monsanto Co., owner of the W. G. Krummerich plant, where the spill occurred, identified the corrosive chemical as about 6,000 gallons of phosphorus oxychloride.

She said seven Monsanto company employees were treated at the plant dispensary for minor irritation and returned to work. The spillage, which occurred about 12:30 p.m., was contained within about an hour, Collins said.

"One theory was that an icicle had formed and dropped onto the nozzle mechanism, setting the chemical free," Collins said. "I don't think they'll really know for sure until they have a chance to investigate tomorrow."

A hospital spokesman St. Mary's Hospital in neighboring East St. Louis said 53 people were treated for eye and lung irritation and released and 12 others admitted for further treatment. None of the injuries was believed serious.

Those helping contain the chemical and aid in the cleanup included a hazardous materials team, Sauget police and an Illinois Environmental Protection Agency representative, state police Sgt. Stephen Brazier said.

The 65 people treated at St. Mary's Hospital were residents of the Rush City section of East St. Louis, adjacent to the plant next to the Mississippi River. Collins said she did not know how many of the plant's 1,200 employees were on duty at the time of the spill.

officials and gladdened opponents of nuclear power.

The three utilities building the Zimmer nuclear power plant said they decided to convert it to a coal-fired plant because of sharply escalating costs and the uncertainties of obtaining an operating license.

The Moscow, Ohio, plant could be ready for operation as an 1,100-megawatt, coal-fired facility by 1991, top executives of the three Ohio utilities said Saturday. Details of the conversion must still be decided, they said.

Construction is being stopped immediately and 2,000 of the 2,500 construction employees there will be fired, said William Dickhoner, president of Cincinnati Gas & Electric Co.

The announcement caught officials of the town of Moscow by surprise.

"Financially, it's going to hurt us over a span. What's going to hurt us worse is they tell me it will be three or four years before any construction takes place," said Mayor Eugene Holland. "It means our payroll taxes are done now for the next three or four years. We'll have to tighten up, as far as the budget."

A number of groups had protested the facility during the 1970s and 1980s on grounds it was unsafe and that emergency evacuation plans were inadequate.

"It's a wonderful day," said David Fankhauser, an early Zimmer opponent in licensing hearings. "It feels like a great weight has been lifted off my shoulders."

W.S. White Jr., chairman of another Zimmer partner, Columbus & Southern Ohio Electric Co., said he knows of no other conversion of a major commercial nuclear plant to coal use. But, he said, "We know of no technical reason why it cannot be done."

Dayton Power & Light Co., the other partner in the project, has estimated that converting the plant would cost \$350 million and take 28 months.

CG&E has said Zimmer is 97 percent complete. The utilities have spent an estimated \$1.6 billion on the plant along the Ohio River about 25 miles east of Cincinnati.

The three utilities serve a combined 1.5 million electric customers in central and southern Ohio and small parts of Kentucky and Indiana near Cincinnati.

Executives of the three utilities said in announcing the decision that they were concerned about a decline in their utilities' bond ratings and Zimmer's ballooning cost of up to \$3.5 billion. They said many details of the conversion still remain to be worked out.

They said they consider nuclear power an important energy source. But, they said, "the economic impact of the uncertainties in the nuclear licensing process was a major reason to pursue converting the Zimmer unit to coal."

(In November 1982, the federal Nuclear Regulatory Commission halted all safety-related construction at Zimmer after allegations of unsafe welding work and missing records on pipe welds in the plant's reactor safety systems. The NRC has continued the ban pending solution proposals.

When announced in 1969, the single-reactor plant was to have cost \$240 million. Bechtel Power Corp., hired to help manage Zimmer, estimated in September that it would cost \$2.8 billion to \$3.5 billion to finish it as a nuclear plant — up from a projected \$1.7 billion a year ago — and that it would not generate electricity until 1986.

William H. Pierce

William H. Pierce,
2356 Reservoir St. N.
3:10 a.m. Sunday



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Pierce. Before his
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Surviving are two
William C. and Dan
both of Springfield; fi
ters, Mrs. Leonard (A
Ann) Maurer and Mrs
ter (Kathryn) Epright
of Springfield; Mrs.
(Margaret) Gerg of R
Dam, Wis.; Mrs. Roy (I
cia) Williams of Morton
Mrs. Richard (Ther
Roberts of Madison.
one brother, Edward
Milwaukee, Wis.; one
daughter; several ni
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Services will be at
Wednesday at the K
Egan and Butler Fun
Home, with the Rev.
ward Groesch officia
Burial will be in Camp
ler National Cemetery

Merle R. Sharp

Merle R. Sharp, 5
3617 North Grand Av
died at 1:55 p.m. Sund
his residence.

He was born in New
lin, the son of the late
liam and Rosa Her
Sharp. A resident of Sp
field since 1943, Mr. S
was employed by the

Elaine Powers

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ENDS WEDNESDAY, JANUARY 25

Dravo thinks it has found a better way to burn waste

At roughly \$200/ton, the incineration of chemical wastes is not a bargain. But the implementation this fall of tough disposal rules under the Resource Conservation and Recovery Act (RCRA) and the need for safe disposal of huge quantities of nondegradable, highly toxic chemicals could make incineration a good buy. At least that is what Dravo Corp. (Pittsburgh) is counting on. The engineering contractor has signed an agreement with West Germany's Bayer to market and build large chemical waste incinerators in this country, using technology developed by Bayer.

The technology is based on Bayer's second incinerator at its Leverkusen plant, built to meet West Germany's Waste Disposal Act of 1972 and Federal Antipollution Act of 1974. The unit, which drew from the design of an incinerator that had been in operation for several years, was started up in late 1977. It handles 25,000 metric tons/year of solid and liquid wastes, while meeting environmental standards (table).

Dravo has been working with Bayer and L & C Steinmueller (Gummersbach), the designer-builder of the unit. Steinmueller has the worldwide rights to market the incineration process. And although Dravo likely will fill the role of engineering contractor in the U.S., Steinmueller officials are quick to point out that Dravo has not acquired the U.S. rights to the process and decisions will be made on a case-by-case basis.

Ultimate way. "This is the ultimate way of waste disposal that we know of—a Cadillac or Rolls-Royce," says Carlisle Gilbert, vice-president of marketing and technical development for Dravo. "You can spend less money on other disposal systems, but they do less." Dravo estimates that the cost of such an incinerator will be about \$25 million.

The Leverkusen incinerator consists of a string of combustion and heat recovery modules, ending with electrostatic precipitators and cyclone and jet scrubbers. Solid and liquid wastes are burned in a rotary kiln, which is followed by a secondary combustion chamber. According to Gilbert, the plant can handle all types of halogenated compounds, including chlorinated hydrocarbons, and organics containing phosphorus, sulfur and silicones, in bulk or in steel drums.

The process produces a slag containing

heavy-metal compounds that could be recovered and particulates from the precipitators that are encapsulated and buried. The remaining pollutants are removed in the scrubbers.

Gilbert says the incinerator operates largely on the energy produced from the waste; very little auxiliary fuel is required. In fact, he says, the waste-heat boiler provides steam for the process and for the overall chemical complex. But, he claims, there is a trick to operating Bayer's incinerator to get maximum disposal and minimum emissions. "It's how you put the cheese on the mousetrap and spring it," Gilbert says. "It will take Dravo's engineering, procurement and construction experience in the U.S., Steinmueller's fundamental design, and the knowledge gained by Bayer operating the facility to make a plant function successfully in the U.S.," says Gilbert.

Current buzzword. "Incineration is the current buzzword, and it's a good buzzword," says Jack Lurcott, director of corporate development at Rollins Environmental Services, a major disposal firm. Once a chemical passes through an incinerator "it no longer exists—it's gone, and what's left behind can readily be handled by land disposal," he adds. Most chemical companies, however, prefer to let disposal firms operate costly incinerators and wrestle with siting problems. Rollins, for instance, has three incinerators. IT Enviroscience (Knoxville, Tenn.), formed in April by the merger of IT Corp. and the former Hydrosience Div. of Dow Chemical, is building an \$84-million waste-disposal facility near major chemical complexes in Geismar, La. (CW, Feb. 13, p. 42). And Rollins' Lurcott points out that building \$30-50-million incinerators is "big business," and that it will take firms in the \$300-500-million/year revenue category to handle future waste incineration projects.

Moreover, he calls the current climate for siting incinerators "scary." Local opposition to such plants is a major

problem, he says. But he is encouraged by action in various state legislatures, particularly in Michigan, New Jersey, New York and Pennsylvania. It will take these states another six months to develop their siting policies, he believes, "and then companies in the private sector will be ready to go."

Misapplication. Rudy Novak, head of waste control at IT Enviroscience expresses another concern. "A good share—25%—of our work is with people who have an incinerator that has not worked. There has been a misapplication. They did not realize the full extent of the problem, and they oversimplified it," he says.

"Incineration doesn't stand well alone," Novak says. "You need to look at the total treatment process." This involves proper identification of the waste problem, including an understanding of the material to be disposed of, and how it is to be handled and stored under RCRA and Occupational Safety & Health Administration regulations. In addition, firms offering waste disposal facilities should be prepared to "participate in public hearings, where their designs must be defended," says Novak.

How Bayer's incinerator measures up to West German standards

Stack-gas components	Milligrams per cubic meter		
	Emissions		State-imposed limit
	Normal	Peak	
Sulfur dioxide	300	800	1,250
Nitrogen oxides	400	1,000 plus*	1,000
Hydrogen chloride	50	100	100
Hydrogen fluoride	3	5	10
Particulates	20	100	100
Organic carbon	5	10	50

*NOX emissions occasionally exceed limit when operating temperature (more than 1,000 C) is boosted for some chlorinated compounds. Source: West German environmental authorities

It is still too early to tell how Dravo will fare with the Bayer technology. However, one firm that has held preliminary discussions with Dravo is interested enough to visit Germany to see the Bayer facility in operation. Kenneth Glatz, process development manager for Waste Management (Oak Brook, Ill.), says the advantages offered by Dravo are "proven technology and experience with specific wastes." One disadvantage of the system might be the cost. For Glatz says disposal firms are facing tougher challenges than in the past, "and the Germans have successfully addressed tough disposal problems."

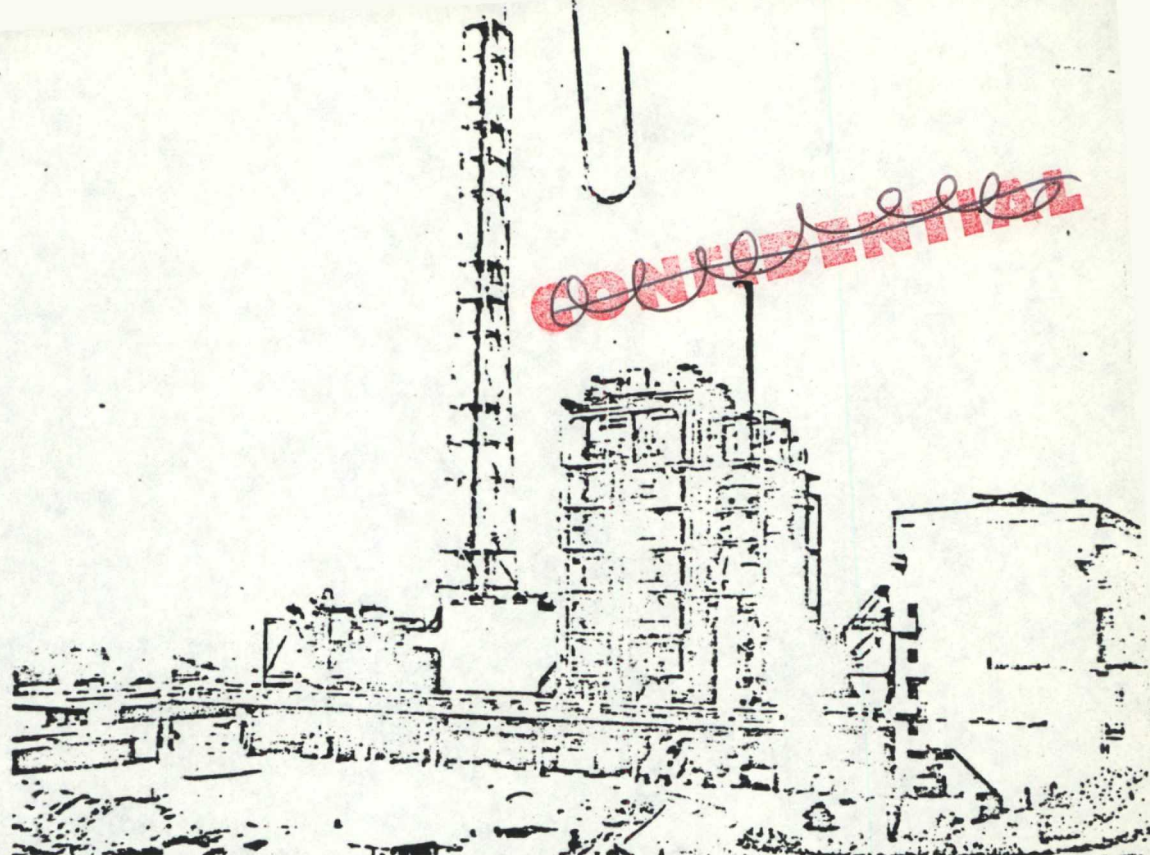


Fig. 1—Over-all view of the No. II incinerator system with flue-gas scrubber, seen from the west.

How Bayer incinerates wastes

This large chemical waste disposal system handles 25,000 tons per year of special wastes and produces 140,000 tons of steam while meeting current environmental rules

H. W. Fabian, P. Reher and M. Schoen, Bayer AG, Leverkusen, Germany

AFTER APPROXIMATELY one year of trials the No. II incinerator system at Bayer's Leverkusen plant was commissioned for regular service in November 1977. The construction of this system with downstream flue-gas scrubber had become necessary as a result of the increasing volume of waste and the additional requirements imposed for the disposal of "special waste."

The system's capacity allows the incineration of approximately 25,000 metric tons of special wastes per annum and produces approximately 140,000 tons of steam. It consists primarily of the waste bunker building, the rotary kiln with secondary combustion chamber including all feed devices for solid, paste and liquid waste, the heat recovery boiler, the electrostatic filter and the flue-gas scrubber which in turn consists of the injection cooler, two rotary scrubbers and one jet scrubber.

The purified flue-gas is heated in two heat exchangers and discharged by a suction blower via a stack of 100 m height. The stack is fitted with sensors and apparatus for the continuous measurement and recording of the type and quantity of the emissions. The scrubbing water is transferred to the company's own waste water treatment plant. Solid ash and dust are deposited in licensed disposal sites.

The system requires an operator staff of 35 persons including the instrumentation and maintenance personnel. The acquisition cost was DM 27 million. The system concept was developed in collaboration with L.&C. Steinmueller, D-5270 Gummersbach. Steinmueller was also the design and construction contractor. The operating cost is DM 10 million per annum. The average incineration cost is DM 400 per ton of waste.

Background. In 1973 the construction of a second incineration system with downstream flue-gas scrubber was decided as a result of the increasing volume of "special waste" generated by the plants of Bayer AG.

It was planned to use this system for the disposal of all "special waste" as defined in § 2.2 of the Waste Disposal Act (Abfallbeseitigungsgesetz) dated June 7, 1972, and in accordance with the Federal Anti-Pollution Act (Bundesimmissionschutzgesetz—BImSchG) dated March 15, 1974, and the Technical Directive on the Prevention

HOW BAYER INCINERATES WASTES

- | | |
|--------------------------------------------|---------------------------------------|
| 1 Solid waste bunkers | 6 Heat recovery boiler |
| 2 Kiln charging system | 7 Electrostatic filters |
| 3 Rotary kiln | 8 Flue-gas scrubber (3-stage) |
| 4 Liquid waste burners | 9 Scrubbing water oxidation |
| 5 Afterburner chamber with emergency stack | 10 Suction blower with heat exchanger |
| | 11 Stack (100 m height) |

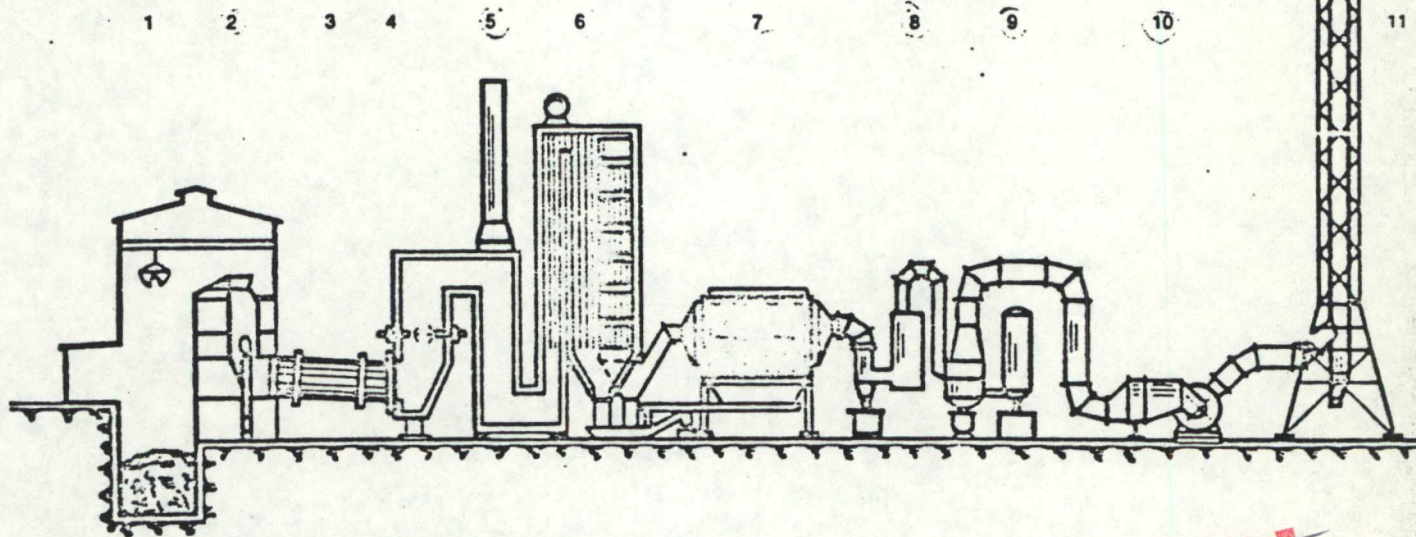


Fig. 2—Process schematic of the No. II incinerator system.

Air Pollution (Technische Anleitung zur Reinhaltung der Luft—TA—Luft) dated Aug. 28, 1974.

The following requirements were imposed on the design and operation of this system and the clean incineration of the "special waste" involved in accordance with the statutes:

1. Incineration must always be preceded by careful analysis and classification of the waste in order to determine the best suited treatment method.
2. The design, process technology and mode of operation of the incinerator system must be suitable for adaptation to the specific waste problems encountered, i.e., the system must be designed so that any change in the quantity and composition of the waste will not cause any malfunction in the process.
3. The design of the combustion spaces and heat recovery systems as well as the materials used for them must minimize the flue gas damage.
4. Finally, the flue-gas scrubbers must be designed so that removal of the pollutants from the flue gas is ensured regardless of quantity and ratio between the individual flue gas components.

SPECIAL WASTE

In order to facilitate special waste handling and to allow a certain classification which is also required for intermediate storage, this waste type was roughly classified into four categories on the basis of the chemical properties:

1. Halogen, nitrogen, sulfur, phosphorous and silicon-containing production waste.
2. Toxic, spontaneously igniting, spontaneously de-

composing and spontaneously polymerizing waste as well as waste generating strong odors.

3. Waste of high reactivity which may react spontaneously with other waste or have a strong corrosive effect, and
4. Miscellaneous waste consisting of minor quantities of highly different waste whose composition is mostly unknown.

Classification under physical aspects would have been possible on the basis of the state of aggregation (solid, liquid) or on the basis of their calorific value which varies from 0 to 40,000 kJ/kg. However, in practical operations such a classification would not have been feasible since the chemical properties dominate.

INCINERATION PROBLEMS

In addition, the concept for the No. II incinerator system had been influenced by some basic considerations arising from the specific incineration problems of some waste types. As an example for these problems, the disposal of chlorine-, phosphorous- and silicon-containing waste and the heavy-metal-containing ash generated upon incineration shall be explained in more detail.¹

Incineration of chlorine-containing waste. In addition to CO_2 and H_2O the incineration of chlorine-containing waste primarily produces HCl . The concentration of the generated HCl can be estimated fairly rapidly if the chlorine content of the waste and the excess air number are known. Thus it can be shown that the limit of 100 mg/nm³ HCl in the exhaust air, which the German air pollution directive requires, will be reached and exceeded even when the waste has a very low chlorine content. For instance, the flue gases of waste contain:

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0.1 by weight chlorine, incinerated with 50% excess air i.e., at $\lambda = 1.5$, already contains 160 mg HCl/nm³. For waste whose chlorine content may be 60% by weight and more, the HCl content in the flue gas will be in the order of several grammes HCl/nm³. The possibility that major quantities of HCl may be generated requires very careful selection of materials and imposes maximum requirements on the efficiency of the flue-gas scrubbers.

Apparently caused by HCl and supported by other aggressive volatile flue-gas components, corrosion damage was also temporarily encountered on system components which, due to their composition of materials, should have resisted this corrosive attack. Some parts made of Hastelloy C in the injection cooler, in the rotary scrubbers and in the droplet traps were completely destroyed after only a few thousand operating hours. Similar damage was also encountered in the heat exchanger and in the suction blower. These damage and malfunction problems have now been corrected through design changes and through the use of improved materials.

In the combustion of chlorinated hydrocarbons the formation of elementary chlorine through oxidation of HCl cannot be theoretically excluded. Chlorine represents a certain danger to metallic system components. The thermodynamic data of this oxidation process, which is referred to as the Deacon reaction, show that chlorine formation is strongly reduced with increasing temperature and increasing water content, but is facilitated with decreasing temperature and increasing HCl and oxygen concentration. At the usual combustion temperatures between 1,200 and 1,300°C, however, the theoretically possible chlorine quantity is only 10 mg Cl₂/nm³ which is negligible.

Considerably more significant, however, is the question as to the change of equilibrium taking place as the flue gases pass through the ducts of the heat recovery boiler until they have cooled to approx. 300°C. In this temperature range the equilibrium concentration of chlorine is so high that the corrosion of the boiler and system components must be feared. It is a known fact that carbon as well as iron and copper oxides have a catalytic effect and accelerate the equilibrium. In fact, a concentration of 200 mg Cl₂/nm³ has been measured in the flue gas during the incineration of copper-containing chlorinated hydrocarbons. The combustion space temperature was 1,100°C, and the flue gases passed the temperature drop from 1,100°C to 600°C in approximately 2 seconds. In addition, the catalytic effect of dust from the electrostatic filter on chlorine formation was studied under laboratory conditions. For these studies a mixture of 90% by volume of air, 9% by volume of water vapor and 1% by volume of HCl was passed through a reaction tube at 500°C filled with glass wool and dust from the electrostatic filter, and the chlorine content determined at the outlet. After a residence period of 15 seconds, chlorine contents up to 800 mg Cl₂/nm³ were determined.

Similar reactions take place in the incineration of bromine and iodine-containing waste. As a result of the lower electron negativities of bromine and iodine, the unfavorable effect arises that the formation of the corresponding halogenated hydrocarbons will shift in favor of free halogens so that increasing quantities of free bromine and iodine are produced.

In order to avoid the problems in systems technology

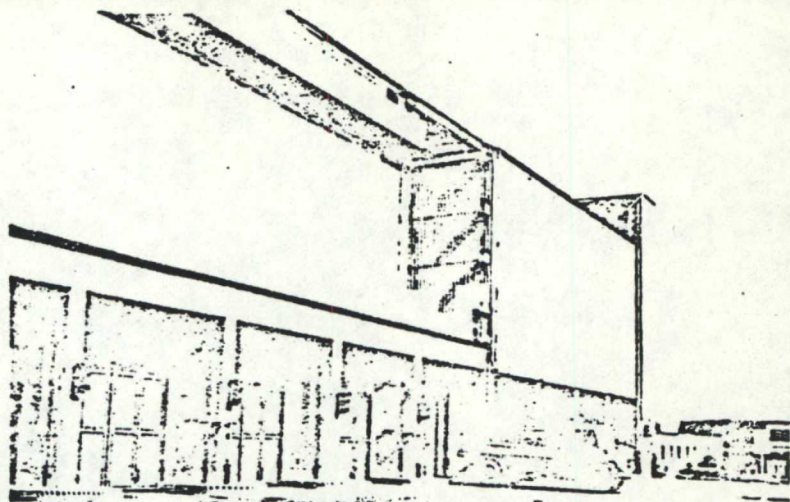


Fig. 3—Bunker building for solid waste; delivery in tipping truck.

and apparatus involved in the possible occurrence of free halogens in the flue gas, it has been found advantageous to incinerate halogen-containing waste together with sulfur-containing waste. Apparently the SO₂ produced during this process will reduce the halogens present to the corresponding halogenides to a degree where not even traces of halogen can be identified by analysis. Therefore, the prerequisite for stopping the halogens in the flue-gas flow is to maintain a constant waste mix and an adequately great SO₂ concentration. As a result of this mode of operation it has been possible so far to avoid any corrosion damage by halogens.

Incineration of polychlorinated compounds. Certain polychlorinated compounds may appear problematic from the point of view of incineration in that they are characterized by their increased thermal stability. Consequently, their complete incineration may require higher temperatures and longer residence times in the combustion zone. Our own studies in this field have shown that, at temperatures above 1200°C and minimum residence times of 1 second, it was impossible to identify any chlorinated compounds in the flue gas, the lower identification limit of the analysis being approximately 0.003 µg/nm³.

Incineration of organic phosphorous compounds. The primary combustion product of organic phosphorous compounds is gaseous phosphorous pentoxide. This compound has extremely unfavorable chemical and physical properties for the process of an incinerator system. Phosphorous pentoxide is fairly volatile, its vapor pressure being 10⁻² Torr at 300°C which is equivalent to 170 mg P₂O₅ per nm³, its melting point is 569°C and its boiling point 591°C. Being the anhydride of a strong tribasic acid, phosphorous pentoxide violently reacts with water even at elevated temperatures, forming metaphosphoric acid. Phosphates of varied basicity are formed in the presence of basic oxides or salts. At temperatures above 600°C reactions with airborne dust deposited on heat exchanger surfaces and on the internals of the electrostatic filters take place with the result that these loose deposits turn into sticky, firmly adhering and difficult to remove incrustations. This will result in increased pressure drop and reduced efficiency of the heat recovery boiler.

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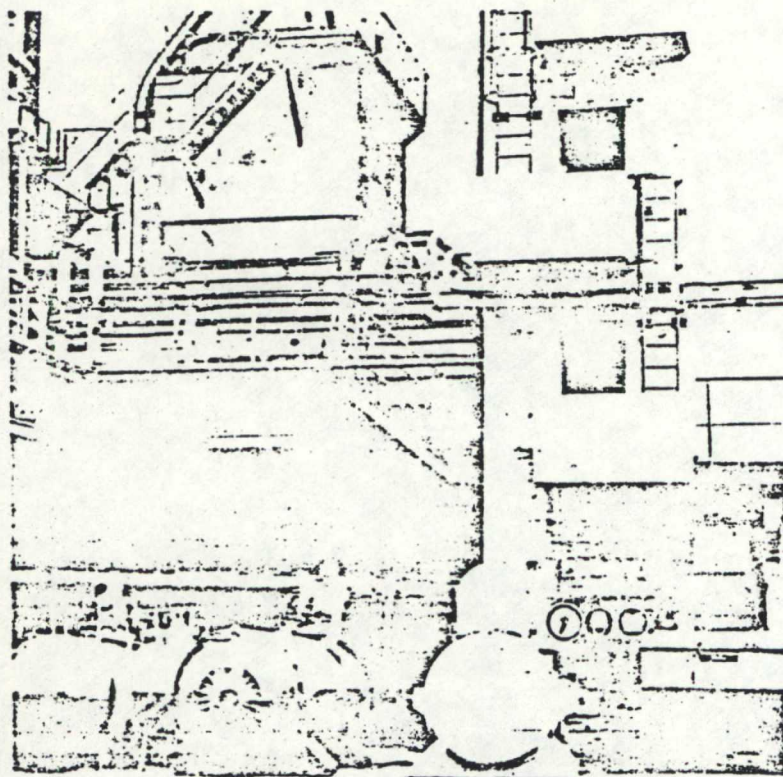


Fig. 4—Incineration of liquid waste from settling tanks.

and electrostatic air filters. In addition, reactions with the boiler walls cannot be excluded. The gaseous P_4O_{10} penetrates the dust deposits and reacts with the protective iron oxide layers on the boiler wall, forming iron phosphates. In addition, it has been observed that, due to the very small temperature interval between condensation point and melting point ($\Delta T = 22^\circ C$), when the phosphorous oxide-containing flue gases cool, it will easily happen that very fine aerosols are produced which are only highly inadequately separated by conventional dust traps. Many experiments and design modifications were necessary in order to find a solution for these problems. In the meantime the process technology and the plant design have been adapted to the point where no emissions are observed even under surging P_4O_{10} loads.

Incineration of organic silicon compounds. Extremely fine silicon dioxide particles are produced during the incineration of organic silicon compounds. SiO_2 has a very high melting point ($1713^\circ C$) and high electrical resistance (10^{12} - $10^{13} \Omega/cm$). Both are adverse properties from the point of view of optimum electrostatic dust separation. As a result of the very high melting point the SiO_2 aerosols from the primary process will not agglomerate into larger particles, and the separation efficiency of the electrostatic filter is correspondingly poor. Due to the high electrical resistance, the electrical charge is transferred very slowly from the deposits to the separation electrodes. The SiO_2 deposits have the effect of a dielectric, impeding the electron flux between spray discharge electrodes and separation electrodes which is necessary for dust separation.

It is found in day-to-day operations that during the

incineration of silicon-containing compounds the separation efficiency will drop below 30 percent of the usual value in spite of increased field strength. In these cases the perforated plates, the spray discharge wires and the separation plates of the electric dust filters are subsequently covered with dust deposits up to 10 mm thickness. Normal vibrating devices are inadequate for the removal of this type of dust accumulation. Ninety-nine percent of this dust consists of SiO_2 ; its density has been determined at $0.05 g/cm^3$. Consequently, the incineration of organic silicon compounds usually requires extensive manual cleaning work in the electrostatic filter systems.

This is another case where the process was optimized through systematic experiments and some redesign to the degree where malfunctions of the type described above no longer occur.

Ash with heavy-metal content. One problem of special significance is the heavy-metal content of slag and ash. In addition to metal compounds which are insoluble in water, a great number of soluble metal compounds in the form of oxides, chlorides or sulfates are produced during the incineration of chemical waste. These compounds, contained in the slag and ash, are easily eluted when the slag or ash is flushed from the system, and thus may get into the waste water. The prevention of this contamination requires additional methods to reduce the heavy-metal content of scrubbing and slag water. One such method, for instance, is the precipitation of heavy-metal ions with milk of lime, forming hydroxides which are almost insoluble in water and can be filtered.

Another problem is the volatility of certain metal compounds. Some metal oxides and chlorides have such a high vapor pressure at temperatures from only 150 to $350^\circ C$ that they will pass the electrostatic filters and, unless there is a flue-gas scrubber, would condense only after further cooling and discharge into the atmosphere. These include predominantly the oxides of arsenic, selenium and phosphorous as well as the chlorides of antimony, arsenic, iron, mercury, tin, cadmium, bismuth, zinc and tantalum. Since some of these compounds are highly toxic, the flue-gas scrubbers must be extremely efficient. For instance, a mercury content of only 0.1% by weight in waste would be sufficient to cause an emission of approximately $120 mg HgCl_2/nm^3$ in the exhaust gas. Or, during the incineration of waste containing 0.1% by weight of $CdCl_2$ and provided that all of the easily soluble cadmium chloride is dissolved in the slag water, the waste water, based on a realistic waste water ratio of $2 m^3$ per ton of waste incinerated, would contain approximately $500 mg CdCl_2/liter$!

WASTE ACCEPTANCE

Waste generated in Bayer AG plants is first reported by the operating departments to the anti-pollution and waste disposal department, using an incineration permit accompanied by a $5 kg$ sample. This incineration permit includes data on the quantity, the precise designation and characteristic components of the waste to be incinerated. Other important information for waste disposal include the type of packaging and/or delivery to the plant, the date of delivery, the state of aggregation of the waste, its combustibility, the flash point, the ignition temperature,

the calorific data, its behavior upon heating, its boiling point, gas generation, reactivity with water, toxicity, any odors generated and the hazard class according to the Flammable Liquid Directive (VbF). Within the waste disposal department the waste acceptance and inspection laboratory group, on the basis of this information and if necessary its own laboratory studies, determines the technically and economically optimum waste disposal method (incineration with or without flue-gas scrubbing, incineration on the high seas, surface or underground disposal), completes the study by assigning an inspection number and communicates the result to the operating department concerned. If the waste disposal department proposes the disposal of waste by incineration, the waste will be delivered to the plant together with a waste way bill which lists predominantly the quantity, number and type of containers, the inspection number and the materials classification code. This materials classification code is important for computing the incineration cost. Practical experience has shown that a rough classification of combustible waste into eight materials classes is best. The incineration cost per materials class varies from DM 165/ton for liquid non-chlorinated waste to DM 885/ton for waste in small containers of highly variable content.

On the basis of the materials classification code the incoming waste is channelled to certain collection points by a control center. Solid halogen-, sulfur- and/or phosphorous-containing waste is collected in a bunker building. This bunker building includes four chambers having a capacity of 200 m³ each. On the basis of their basicity, neutral, basic or acid wastes are segregated and collected in a certain chamber each. The fourth chamber is available for special waste types. Liquid halogen-, sulfur- and/or phosphorous-containing waste is either incinerated directly from settling tanks (maximum capacity 10 m³) or collected in larger tanks (capacity approx. 400 m³) for intermediate storage. The method used is decided on the basis of the quantities generated and the chemical compatibility of the different waste types. Highly reactive, decomposing and/or generally difficult to handle waste is delivered in combustible plastic drums whenever possible (capacity 60 to 100 liters), handled via a separate drum elevator and dropped with drum into the rotary kiln for incineration.

NO. II INCINERATOR SYSTEM

The process concept for the No. II incinerator system was developed on the basis of the specific waste situation prevailing at Bayer's Leverkusen plant with due consideration to the theoretical studies above. The practical experience acquired in several years of operation on No. I incinerator system proved highly advantageous for the detailed planning effort.²

One new feature of this process is the multi-stage flue-gas scrubber system. Other design modifications included the configuration of the ash bunkers, the lay out and design of the afterburner chamber and the design of the heat recovery boiler.

The process schematic of No. II incinerator system is shown in Fig. 2. The functions of the individual system components are described below.

The most important technical specifications of this system have been compiled in the following table:

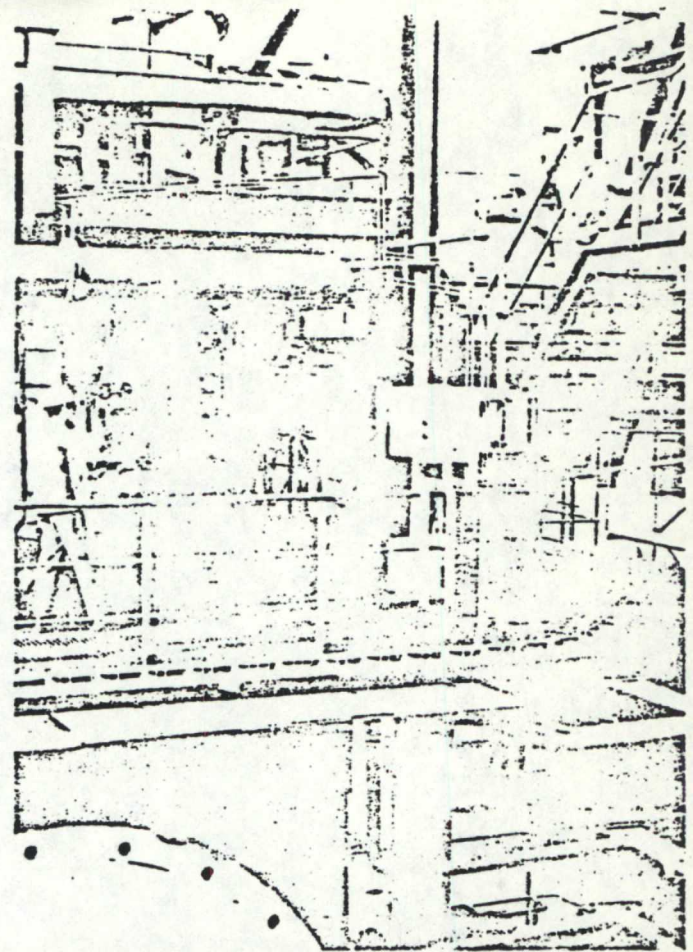


Fig. 5—Rotary kiln with upright, 2-duct afterburner chamber.

Bunker building Waste acceptance Waste charging system	4 chambers 1 grapple 1 plate conveyor 2 slide gates 1 charging ram 1 drum elevator	200 m ³ capacity per chamber 0.8 m ³ capacity 3-4 ton/hour approx. 2-minute cycles capacity 2-3 ton/hour
Rotary kiln		length 13.5 m diameter 3.5 m maximum thermal load 15 Gcal/hr (approx. 60 GJ/hr)
Solid waste incineration (see above)		
Liquid waste incineration	various settling tanks tank farm 1 sustaining burner 1 injector 1 blower 1 blower	capacity 3-5 m ³ several tanks capacity 300 kg/hr capacity 37,000 m ³ /hr capacity 5,400 m ³ /hr 1,100 to 1,200° C
Sludge incineration Combustion air Cooling air Flue-gas outlet temperature		
Afterburner chamber Secondary combustion	various settling tanks tank farm 3 liquid burners 1 booster burner	capacity 1-5 m ³ several tanks capacity 300 kg/hr per burner capacity 50 kg/hr
Residence time Flue-gas flow rate		2-4 secs. 40,000-50,000 nm ³ /hr, max. thermal load 20 Gcal/hr (approx. 80 GJ/hr) 1,200-1,300° C
Flue-gas outlet temperature		
Heat recovery boiler Heat recovery Flue-gas outlet temperature	4 ducts	20 ton steam/hr, 38 bars, 350° C 300° C
Electrostatic filters Dry dust removal		max. 20 kg dust/hr
Flue-gas scrubber Cooling and HCl separation Residual dust separation Alkaline scrubber Sulfite oxidation Exhaust air outlet temperature	1 injection cooler 2 rotary scrubbers 1 jet scrubber 2 columns	6-8 m ³ water/hr 5-25 m ³ water/hr 2-12 m ³ water/hr 60° C 140° F
Waste-air heating Suction blower	2 heat exchangers 1 ducted-impeller blower	capacity 60,000 m ³ /hr, drive rating 335 kW
Stack	insulated steel tube instrumentation and recording devices	height 100 m waste-air outlet velocity, 12-15 m/sec.

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CHARGING SYSTEMS

Solid waste charging. Solid waste is predominantly delivered in tipping lorries and collected in a sealed bunker building. Bulky materials are crushed in an impact mill. The charging hopper located above the rotary kiln inlet is charged by a grapple which is controlled from a fully air-conditioned operator cab which is sealed against the bunker space, using TV cameras and TV screens in a partially automatic, partially manual operation. The rotary kiln inlet is sealed against the bunker space by a lock fitted with two sliding gates. When the inclined sliding gate (in the drop chute of the rotary kiln inlet) is closed, a horizontal sliding gate located in the charging hopper will open.

A continuously operating plate conveyor belt located below moves the waste into the drop chute and deposits it on the inclined sliding gate. After a certain cycle time the horizontal sliding gate will open and the waste will drop down an inclined chute into the rotary kiln inlet. Any waste remaining on this inclined chute is pushed down by a ram.

Liquid waste charging. Liquid waste is delivered in sealed settling tanks having a capacity up to 10 m³. Part of the liquid waste is incinerated directly from these settling tanks while another part is collected for intermediate storage in larger tanks (400 m³ capacity) prior to incineration.

The transport of this liquid waste to the individual incineration points is accomplished via pumps or under nitrogen pressure (3 bars). Waste oil containing solids is first purified in a screening machine. The screen residue with a particle size of over 2 mm is moved by a compressed-air conveyor system (Gulliver gun) via a pipe line directly into the rotary kiln. Some of the waste delivered in settling tanks requires liquefaction through heating prior to combustion so that it can be pumped and atomized in the burners.

Steam outlets at up to 30 bars pressure are available for this purpose. After removal of the waste from the settling tanks through pressure, the tanks are de-pressurized via gas lines terminating in the afterburner chamber via intermediate safety devices. Waste liquids of low calorific value are atomized together with waste having high calorific value in multiple-fuel burners and incinerated. Atomization is accomplished either with steam or with compressed air.

These burners are located in the face side of the rotary kiln (1 burner) and in the wall of the afterburner chamber (3 burners, 1 booster burner). Burner monitoring is accomplished via a temperature sensor system. When the temperature drops below 1050°C a booster burner fired with natural gas is ignited, supporting the main burners. If the temperature continues to drop below 950°C, the fuel feed is interrupted by quick-action valves.

Charging of problematic waste in small containers. A separate system is available for charging the system with waste in small containers (cans, drums) which consist predominantly of an elevator, a roller conveyor, a lock with two sliding gates and a tilting table from which the small containers are dropped into the rotary kiln.

This charging system is interlocked by the control system, so that these small containers can be dropped into the rotary kiln only when the inclined sliding gate is closed. This insures that there will not be any interference between the drum charging system and the solid waste charging system.

Rotary kiln, afterburner chamber. The rotary kiln has a length of 13.5 m and an outer diameter of 3.50 m. The ceramic refractory liner has a thickness of 0.25 m. Consequently, its inner diameter is approximately 3 m. The rotary kiln is inclined 3 percent toward the outlet end.

The average rotating speed is approximately 9 revolutions per hour. It is infinitely variable between 7 and 24 revolutions per hour. The residence period of the waste in the rotary kiln is approximately 1½ hour. The internal temperatures reach 1,200 to 1,300°C. The hottest zone is located in the 7 to 11 m range. This is the zone where the strongest corrosion and erosion attack takes place. It is attempted to keep this attack within justifiable limits through the selection of extremely high-quality refractory materials and the continuous presence of a protective slag layer. At the discharge from the rotary kiln the slag drops into a water-filled plate conveyor slag removal system. The slag is free of any pollutants and can be deposited at a disposal site without any danger. The combustion air at a rate of approx. 40,000 nm³ h is aspired from the bunker building and injected into the rotary kiln inlet below the solid waste charging system. The gross thermal rating of this rotary kiln is approx. 60 GJ (15 Gcal).

A circular, 2-duct, upright afterburner chamber is placed immediately downstream of the rotary kiln. Its height is approx. 9 m and its inner diameter 4.10 m. Both ducts are provided with a liner of high-temperature ceramic refractories. At approximately half the height of the first duct three liquid burners with an average throughput of approximately 300 kg/h per burner are distributed over the circumference.

In continuous operation this arrangement will achieve intensive admixture of the flue gases, combustion temperatures up to a maximum of 1300°C and a residence period of 2 to 4 seconds. Secondary air nozzles are installed above these burners for safety reasons through which additional combustion air can be injected. The entire inner space of the rotary kiln can be inspected from a port located in the base of the first afterburner duct. This has special advantages for the continuous inspection of the rotary kiln refractory liner and the protective slag layer in the kiln.

The second duct serves as an abatement chamber, and its bottom end has an ash collection space. This space can be cleared at certain time intervals through a port of several square meters area which is closed by four bulkheads; a front end loader is used for ash removal. Continuously operating conveyor devices have not been found feasible at this point. The afterburner chamber is designed for an over-all thermal rating of 80 GJ (20 Gcal).

Heat recovery boiler. The flue gases departing from the afterburner chamber at approx. 1200°C are cooled to about 300°C in the heat recovery boiler, generating approx. 20 tons of steam per hour at 38 bars and 350°C. This heat recovery boiler is an upright 4-duct boiler type. The first two ducts are empty ducts with radiative heating

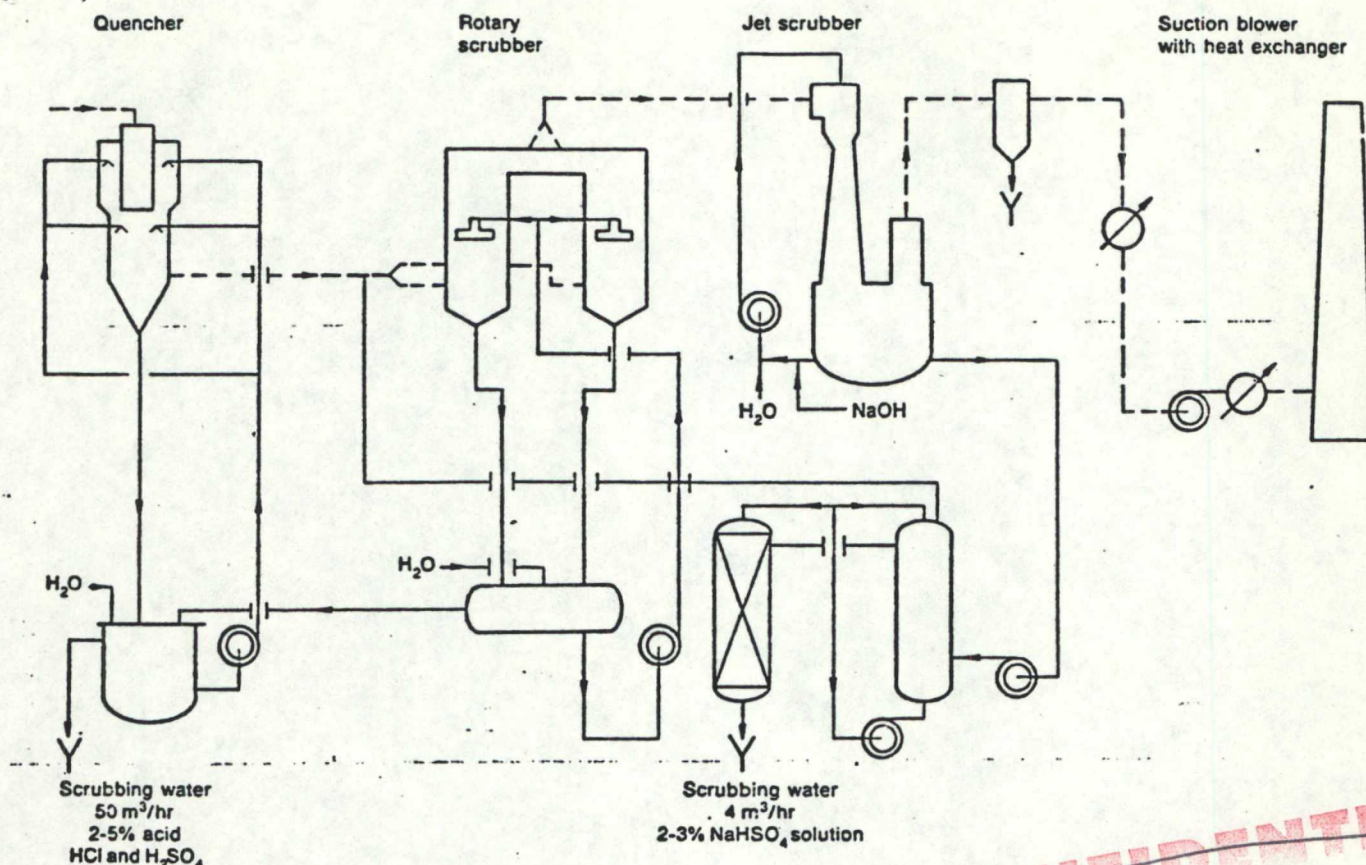


Fig. 6—Schematic of the flue-gas scrubber system.

surfaces. The last two ducts contain superheater, evaporator and economizer.

These boiler ducts have been made of finned tubing cooled by natural circulation. The contact heating surfaces have been welded from square tubing, forming smooth elements that are easy to clean with soot blowers, and connected to a forced circulation cooling system. The rotary kiln charging system and the heat exchangers used for heating the scrubbed flue gases are also installed in this cooling circuit.

Flue-gas scrubbers. In addition to CO_2 and H_2O the combustion of chemical waste produces predominantly SO_2 , HCl , NO_x and dust as well as minor quantities of HF , SO_3 and P_4O_{10} whose quantities in the flue gas have been limited under the Anti Air Pollution Directive (TA-Luft), so that most of them must be scrubbed from the flue gas.

The concept definition for the flue-gas scrubbing system was based on the assumption that the flue gases will contain an average of 10 g HCl/nm^3 , $2.5 \text{ g SO}_2/\text{nm}^3$ and 2 g dust/nm^3 , and that multiples of these concentrations may easily occur under peak loads. The quantities of HF , NO_x , SO_3 and P_4O_{10} were considered to be of minor significance.

The dry portion of the combination dry-wet flue-gas scrubbing system consists of the electrostatic filter and the 3-stage wet portion of the injection cooler (quench), the two rotary scrubbers in a parallel configuration and the jet scrubber.³

The majority of the dust is precipitated from the flue

gases at approx. 300°C in the electrostatic filter. The filter efficiency is approx. 90-95%. The precipitated dust is removed by a scraping conveyor belt, collected in a covered tipping lorry and deposited at a solid-waste disposal site. This procedure has the advantage that any heavy metals contained in the dust and/or precipitated together with the dust cannot get into the subsequent wet scrubbing system where it would be dissolved in the form of chlorides or sulfates which could interfere with the biological treatment process of the liquid-waste treatment plant.

In the injection cooler the flue gases arriving from the electrostatic filter are cooled from 300°C to a level of $60\text{-}70^\circ\text{C}$ and, at the same time, the majority of the HCl is separated. The cooling and scrubbing water required for this purpose is re-circulated. The evaporation losses are compensated by $6\text{-}8 \text{ m}^3/\text{hr}$ make-up water. The design of this section of the system and the materials used have been selected in accordance with the enormous thermal and corrosive loading of this section. The HCl concentration of the departing scrubbing water varies from 2-5 percent.

From the injection cooler the flue gas passes into two parallel rotary scrubbers. In these scrubbers the flue gases pass through a dense cloud of very fine water droplets generated by two rapidly rotating paddle-wheels.

These rotary scrubbers have three functions: (1) separation of any residual dust and extremely fine dust as well as volatile metal compounds; (2) separation of sulfuric acid aerosols which may be generated in considerable

HOW BAYER INCINERATES WASTES

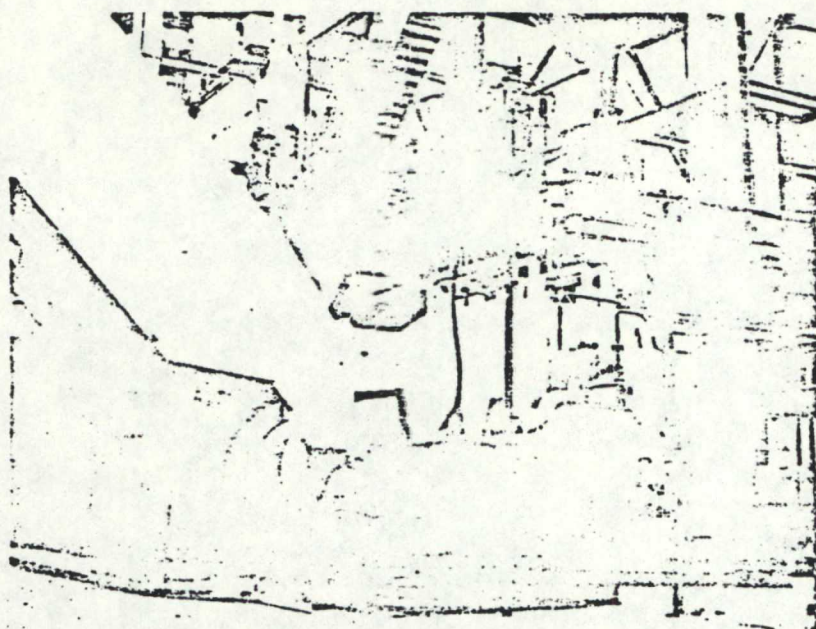


Fig. 7—Suction blower with heat exchanger for reheating the purified flue gases.

quantities in the injection cooler when the flue gases have certain compositions; (3) separation of the total dust if the electrostatic filter fails or if dust penetration occurs under excessive loads.

The scrubbing water is collected in a manifold and pumped out from this point. 2-5 m³/hr fresh water is fed into this manifold in order to prevent any sludge accumulation. The overflow is passed to the collection point for transport to the liquid-waste treatment plant. Compared to other comparable scrubbers this rotary scrubber has the advantage of being insensitive to gas flow rate fluctuations, ensuring a high solids concentration (up to 200 g/liter) and having a lesser pressure drop (approx. 50 mm WC).

The latter effect was decisive for the decision in favor of this scrubber type. It meant that a flue-gas suction blower of lower pressure (400 mm WC), slower speed and lesser noise pollution could be installed.

Downstream of the rotary scrubbers the jet scrubber, using a weakly alkaline medium, is the third scrubbing stage. In this scrubber especially the SO₂ in addition to residual HCl, chlorine and NO_x are removed. In principle this scrubber is an over-dimensioned water jet pump. The scrubbing water is injected in the direction of the gas flow at a pressure of 3-6 bars. The downward velocity of the scrubbing water is 25-35 m/sec, that of the flue gas 10-20 m/sec.

As a result the scrubber automatically aspires the flue gas. The small pressure gain is adequate to overcome the internal drag. The scrubbing water is collected in a manifold and re-circulated. Scrubbing water losses are compensated by approx. 2 m³ fresh make-up water per hour. The scrubbing water pH value is maintained constant at a certain adjustable value by means of a measuring and control device. The pH value of the scrubbing water is adjusted by adding sodium hydroxide solution.

The Na₂SO₄ and NaHSO₄ produced through reaction of SO₂ with sodium hydroxide in this jet scrubber must

be oxidized into Na₂SO₄ prior to discharging the scrubbing water into the liquid-waste treatment facility. A specially developed 2-stage facility is used for this purpose where the oxidation is accomplished instantaneously at temperatures between 70 and 90°C. The discharge scrubbing water contains approx. 5% Na₂SO₄ and is passed to the liquid-waste treatment plant together with the overflow from the injection cooler and the jet scrubbers.

The entire wet section of the flue-gas scrubbing system is provided with an internal rubber liner for corrosion protection. Numerous instrumentation and control points monitor and control the scrubbing process. The cost of flue-gas scrubbing is approx. DM 100 per ton of waste incinerated.

Flue-gas drying and heating. In order to prevent condensation and corrosion in the stack and to ensure rapid dispersion of the purified waste air in the atmosphere, two droplet traps and two heat exchangers (flue gas heaters) have been installed between the jet scrubber and the stack. The first droplet trap is located immediately downstream of the jet scrubber and the second stream of the first heat exchanger.

Waste-air heating is accomplished in two stages. The suction blower required to produce the necessary negative pressure in the different system components and to move the purified waste air into the atmosphere via an isolated stack of 100 m height is located between the heat exchangers. The hot water required for the heat exchangers is obtained from the natural circulation of the heat recovery boiler.

This flue gas reheating process requires approx. 5 t hot-water steam per hour, equivalent to 35,000 t steam per annum at a cost of approx. DM 0.5 mill for an average of 7,000 hours of operation per annum. If this reheating system were eliminated, the incineration cost could be reduced by 5-10%.

Efficiency. The energy efficiency of this system is computed as follows: under normal load approx. 1.8 t of solid waste and 1.2 tons of liquid waste as well as approx. 0.6 tons of small-container waste are incinerated per hour. This waste has an over-all calorific value approx. 83.7 GJ (20 Gcal). Out of this quantity, 9.2 GJ/hr (2.2 Gcal/hr), equivalent to 11%, is required for re-heating the purified waste gases. The remaining 40% includes 29.4% over-all heat losses (radiative losses on the rotary kiln, the afterburning chamber and the boiler, heat losses in the injection cooler and heat removal via the flue gases), and 10.6% for operational uses of the plant.

ANTI-POLLUTION REQUIREMENTS

The license granted by the Düsseldorf Licensing Authority on Dec. 31, 1974, established the following maximum emission values for the No. II incinerator system:

SO ₂	1,250 mg/nm ³ waste air
NO _x	1,000 " " "
HCl	100 " " "
HF	10 " " "
Dust	100 " " "
O ₂	11% by volume

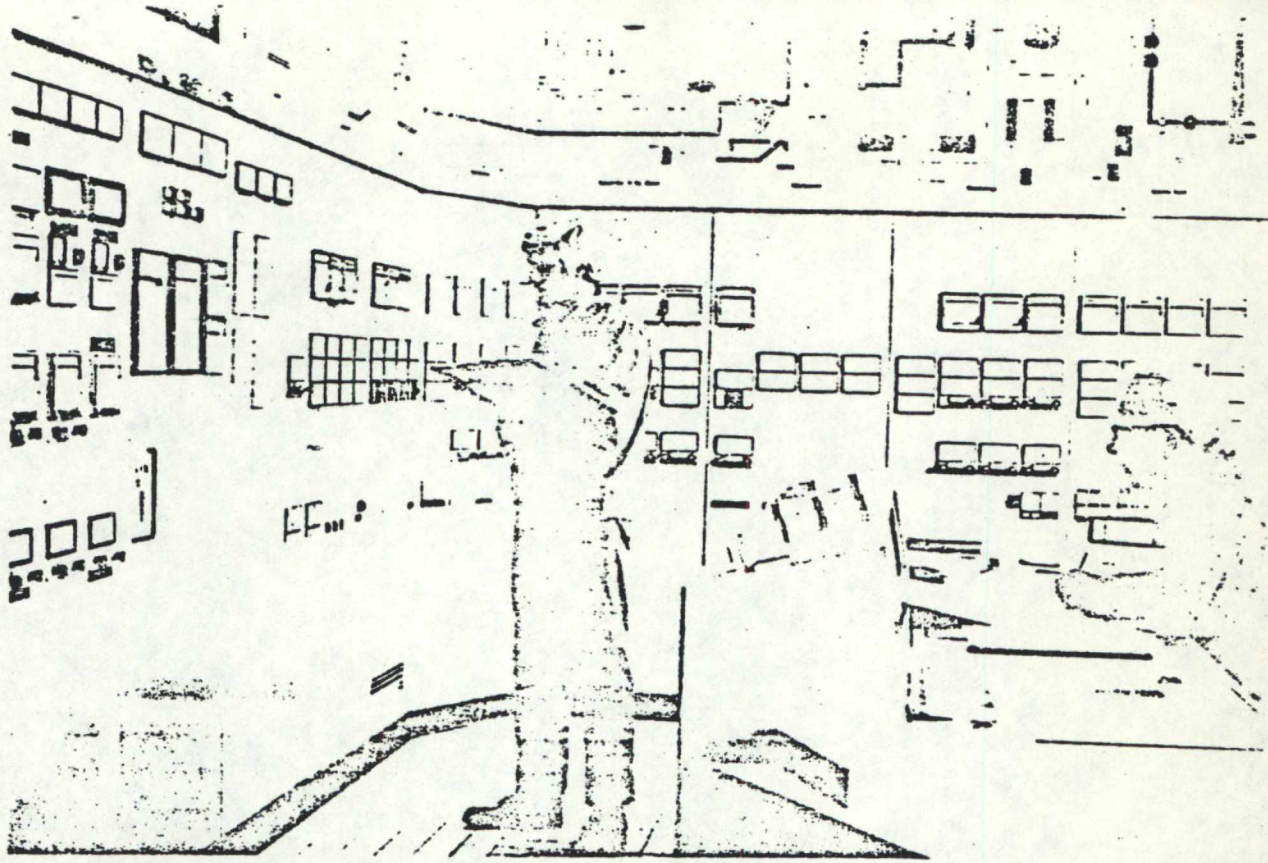


Fig. 8—Control center for the No. II incinerator system.

These components must be measured continuously for anti-pollution monitoring. For some components the monitoring is accomplished by means of continuously recording apparatus.

Systematic flue gas analysis under different loads and modes of operation was accomplished during the period from 6,000 to 8,000 hours of operation in order to study the efficiency of the flue-gas scrubbing system. The following results have been achieved:

Flue-gas component	Normal load (in mg/nm ³)	Peak load (in mg/nm ³)
SO ₂	300	800
NO _x	400	up to 1000 and more
HCl	50	100
HF	3	5
Dust	20	100

On the whole the anti-pollution limits are maintained. They are occasionally exceeded with respect to NO_x. This has not been due to deficiencies in the apparatus or in the process, but to the fact that the physical and chemical properties of nitrogen oxides render any absorption very difficult. To this date no scrubbing process has been developed where separation efficiencies are achieved which are comparable to those achieved when scrubbing SO₂ and HCl.

In addition, the license requires all waste water and scrubbing water to be treated in a biological liquid-waste treatment plant.

Under normal operating conditions the afterburner chamber must be operated at a minimum temperature of 1000°C and a minimum residence period of 0.3 secs. The minimum temperature must be increased to 1200°C for the incineration of polychlorinated compounds.

The afterburner chamber temperature must be moni-

tored by continuously recording apparatus. If the temperature drops below 1000°C, the charging system of the rotary kiln must be stopped.

ACQUISITION COST, PLANNING AND ERECTION TIME

The investment to acquire a capacity of 25,000 tons per annum of chemical waste amounted to DM 27 million. The system concept was developed jointly with L. & C. Steinmüller GmbH, D-5270 Gummersbach, who were also the designers and contractors for the construction of the facility. The planning period extended over two years. Erection required one year. During the three years of planning and construction this project secured approximately 100 jobs. The operating cost is DM 10 million per annum. Consequently, the average incineration cost is approx. DM 400 per ton of waste.

After trial operation of approx. 7,000 operating hours the No. II incinerator system of Bayer AG's Leverkusen plant was commissioned for regular service in November 1977. This system has passed the performance tests, achieving the specified operating parameters and has demonstrated its efficiency. It was presented to the public in a brief ceremony on Jan. 18, 1978.⁴

The trend of the waste situation during the next one or two decades can be estimated on the basis of two facts:

1. The Leverkusen plant has reached its maximum expansion level, and
2. Low-waste technologies are used with preference when new products are marketed.

The conclusion may be drawn that the amount of production waste of the type described in this article will

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not increase significantly in the short run. Therefore, the construction of a third incinerator system is not contemplated.

POSTSCRIPT

One important item in the planning concept was the company requirement for a maximum of continuous mixing and transport of the different waste materials with respect to their calorific value and quantity in order to create uniform thermal conditions in the combustion spaces. In this respect a problem was created by the so-called small waste containers, cans or drums of 60 to 100-liter capacity and having a great variety of contents.

These small containers are filled with solid, paste and liquid production or laboratory waste in pure or mixed form whose calorific value fluctuates from 0 to 10,000 kcal/kg. The composition of these small container wastes may vary greatly. Often the contents are toxic, frequently they are not admixable, some of them will burn very slowly, but most of them spontaneously, and they sometimes react with great sensitivity to air and humidity.

The general practice of dropping the small containers into the rotary kiln without emptying them has process disadvantages. Occasionally there will be deflagrations with strong soot generation and excessive thermal and mechanical loading of the kiln refractories resulting from this practice.

About the authors

HORST W. FABIAN is department director responsible for waste disposal at the Leverkusen works of Bayer AG. Dr. Fabian obtained his technical degree from the Technical University in Hanover, Germany, and joined Salzdettfurth AG where he was head of the bromine plant and the laboratory before transferring to Chemische Düngefabrik AG. He joined Bayer AG in 1965 working on the operation of incineration plants for chemical waste, sewage treatment plants and chemical process water waste treatment.



PETER REHER is group engineer responsible for the waste disposal and water pollution control plants at Leverkusen for Bayer AG. Dipl.-Ing. Reher studied process engineering at the Technical University in Aachen and first joined Uhde in Dortmund. He first joined Bayer AG in the planning and coordination of the construction of sulfuric acid plants and in their operation.



M. SCHOEN is head of Incinerator Plant II at Leverkusen for Bayer AG. Dr. Schoen studied chemistry at the Humboldt University and the Technical University of Berlin. He joined Bayer AG in the Enamel Department and became head of the laboratory for industrial scale manufacture of glass fiber products.



In order to prevent these defects, paste and liquid small-container contents should be pressed into liquid nitrogen, granulated under nitrogen shielding, mixed and removed from the nitrogen bath into the rotary kiln by a conveyor system.⁵

This type of system would have been an elegant solution for all process problems arising in conjunction with these small-container wastes. Unfortunately, it would have caused some difficulties which were not accurately predictable and/or could not be exactly determined through preliminary studies:

1. The freezing characteristics of different organic wastes and waste mixtures vary greatly. One special disadvantage is that certain groups of materials will form continuous layers of incrustations floating on the nitrogen surface or adhering to the inner walls of the containers which do not settle on the bottom so that they cannot be removed and will gradually clog the system. Other groups of materials will freeze into minute crystals suspended in the liquid nitrogen bath, gradually enriching and forming a thick paste of crystals which finally agglomerates and blocks the conveyor system.
2. The small-container waste is mostly highly heterogeneous. Plastic film, plastic beakers, leather and rubber gauntlets as well as glass bottles are frequent accompanying products. Where these materials get into the liquid nitrogen bath, they will quickly clog the granulator and the transport screw. The necessary repairs are time-consuming and require many man-hours and, moreover, they are not entirely free of danger since reactive mixtures or explosive vapors, air mixtures can form during thawing, or toxic substances may be released.

Since these difficulties involved in retention of the concept could have been resolved only at additional enormous effort in terms of research and process development, if at all, it was attempted to optimize the combustion conditions through design modifications in the incinerator system itself and through process modifications so that even these problematic waste types could be properly disposed of without the disadvantages named above. These experiments which might be the subject of a later article have been successful every step of the way so that these problems may now be considered resolved.

This example was given to indicate that the apparently direct approach will not always yield the desired success. It may be possible that, in view of the increasing complexity of the problems, detours will become increasingly unavoidable which will be associated with high cost and will be very time consuming.

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